

AMENDMENTS TO THE CLAIMS

The claims in this listing will replace all prior versions, and listings, of claims in the application.

1. (Withdrawn) A trench capacitor for use in a semiconductor memory cell, the capacitor comprising:

a trench formed in a semiconductor substrate;

a first and second conducting capacitor plate each located in said trench;

a dielectric layer located between said first and second capacitor plates, as a capacitor dielectric;

an isolation collar in an upper region of said trench; and

an optional conducting filling material, filled into the trench;

wherein said dielectric layer has been applied by one of an ALD, ALCVD, and CVD method.

2. (Withdrawn) The trench capacitor as claimed in claim 1, wherein said first capacitor plate is a region of increased doping in the semiconductor substrate in a lower region of said trench and said second capacitor plate is said conducting filling material.

3. (Withdrawn) A trench capacitor for use in a semiconductor memory cell, the trench capacitor comprising:

a trench formed in a semiconductor substrate;

a first and a second conducting capacitor plate, located in said trench;

a dielectric layer, located between said first and said second capacitor plates, as the capacitor dielectric;

an isolation collar in an upper region of the trench; and

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an optional conducting filling material in said trench;

wherein:

said first capacitor plate is a region of increased doping in the semiconductor substrate in a lower region of the trench; and

a first metal electrode layer is provided on said dielectric layer inside said trench as said second capacitor plate.

4. (Withdrawn) The trench capacitor as claimed in claim 3, wherein a second metal electrode layer is provided in the upper region of said trench and is in electrical connection with said first metal electrode layer, and said second metal electrode layer optionally fills the upper trench region.

5. (Withdrawn) A trench capacitor for use in a semiconductor memory cell, the capacitor comprising:

a trench formed in a semiconductor substrate;

a first and a second conducting capacitor plate located in said trench;

a dielectric layer located between said first and said second capacitor plates, as a capacitor dielectric;

an isolation collar in an upper region of said trench; and

an optional conducting filling material, filled in said trench;

wherein:

a third metal electrode layer is provided between said dielectric layer and the semiconductor substrate as said first capacitor plate; and

a fourth metal electrode layer is provided on the other side of said dielectric layer as said second capacitor plate.

6. (Withdrawn) The trench capacitor as claimed in claim 5, wherein:
a second metal electrode layer is provided in the upper region of the trench and is in electrical connection with said fourth metal electrode layer; and
said second metal electrode layer optionally fills the upper trench region.
7. (Withdrawn) The trench capacitor as claimed in claim 5, wherein said dielectric layer and said fourth metal electrode layer are led into a region of said isolation collar.
8. (Withdrawn) The trench capacitor as claimed in claim 7, wherein said third metal electrode layer is led into the region of said isolation collar.
9. (Withdrawn) The trench capacitor as claimed in claim 3, wherein one of said first metal electrode layer, second metal electrode layer, third metal electrode layer, fourth metal electrode layer and said dielectric layer have been applied by one of an ALD, ALCVD and CVD methods.
10. (Withdrawn) The trench capacitor as claimed in claim 3, wherein one of said first, second third and fourth metal electrode layers comprises at least one of the following materials:
TiN, WN, TaN, HfN, ZrN, Ti, W, Ta, Si, TaSiN, WSiN, TiAlN, WSi, MoSi and CoSi.
11. (Withdrawn) The trench capacitor as claimed in claim 1, wherein said trench has a lower widened region.
12. (Withdrawn) The trench capacitor as claimed in claim 1, wherein said dielectric layer comprises at least one of the following materials:

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Al_2O_3 , Ta_2O_5 , ZrO_2 , HfO_2 , Y_2O_3 , La_2O_3 , TiO_2 ; Al-Ta-O , Al-Zr-O , Al-Hf-O , Al-La-O , Al-Ti-O , Zr-Y-O , Zr-Si-O , Hf-Si-O , Si-O-N , Ta-O-N , Gd_2O_3 , SNO_3 , La-Si-O , Ti-Si-O , LaAlO_3 , ZrTiO_4 , $(\text{Zr}, \text{Sn})\text{TiO}_4$, SrZrO_4 , LaAlO_4 and BaZrO_3 .

13. (Withdrawn) The trench capacitor as claimed in claim 1, wherein said conducting filling material is composed of a first conducting filling layer in a lower trench region and a second conducting filling layer in the upper trench region.

Claims 14-16. (Canceled)

17. (Withdrawn) A method for producing a trench capacitor for use in a semiconductor memory cell, the method comprising:

- forming a trench in a semiconductor substrate;
- providing a first and a second conducting capacitor plate in the trench;
- providing a dielectric layer as the capacitor dielectric, between the first and the second capacitor plates;
- forming an isolation collar in an upper region of the trench;
- optionally filling a conducting filling material into the trench;
- providing a third metal electrode layer between the dielectric layer and the semiconductor substrate as the first capacitor plate; and
- providing a fourth metal electrode layer on the other side of the dielectric layer as the second capacitor plate.

18. (Withdrawn) The method as claimed in claim 17, further comprising providing a second metal electrode layer between the isolation collar and the conducting filling material in the upper region of the trench, wherein the second metal electrode layer is in electrical connection with the fourth metal electrode layer.

19. (Withdrawn) The method as claimed in claim 17, further comprising leading the dielectric layer and the fourth metal electrode layer into a region of the isolation collar.

20. (Withdrawn) The method as claimed in claim 19, further comprising leading the third metal electrode layer into a region of the isolation collar.

21. (Canceled)

22. (Currently Amended) The method according to claim ~~[[14]]~~ 23, wherein the first conducting capacitor plate is entirely buried in the trench.

23. (New) A method for producing a trench capacitor, for use in a semiconductor memory cell, the method comprising:

forming a trench in a semiconductor substrate;

providing a first conductive capacitor plate in the trench;

providing a dielectric layer as a capacitor dielectric on the first conductive capacitor plate;

providing a first metal electrode layer on the dielectric layer inside the trench as a second conductive capacitor plate;

filling the trench with a conductive filling material and etching back the conductive filling material to the upper side of the first conductive capacitor plate;

forming an isolation collar in an upper region of the trench; and

providing a second metal electrode layer in the upper region of the trench such that the second metal electrode layer is in electrical connection with the first metal electrode layer,

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wherein at least one of the dielectric layer, the first conductive capacitor plate, the first metal electrode layer, and the second metal electrode layer is applied by one of an ALD, an ALCVD, and a CVD method.